Non-uniform distribution problems

1. A non conducting sphere of radius a contains a charge with density given as p=αr, where α is a positive constant.

Find

1. The total charge Q contained within radius a
2. The expression for the electric field for r > a
3. The expression for the electric field for 0 < r < a
4. A spherical cloud of radius R contains a total charge of +Q with a non-uniform volume charge density that varies according to the equation:

p(r) = po(1 – r/R) for r < R and p = 0 for r > R

where r is the distance from the center of the cloud. Express answers in terms of Q, R and constants.

R P

1. Determine the following as a function of r for r > R.
2. The magnitude E of the electric field
3. The electric potential, V
4. A proton is placed at point P shown above and released. Describe its motion for a long time after release.
5. An electron of charge magnitude e is now placed at point P, which is a distance r from the center of the sphere, and released. Determine the kinetic energy of the electron as a function of r as it strikes the cloud.
6. Derive an expression for po
7. Determine the magnitude E of the electric field as a function of r for r < R.